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## USES AND DOSAGES OF CRYOLITE FOR INSECT CONTROL

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Crop and Garden Insect Investigations<sup>1/</sup>

The use of cryolite for insecticidal purposes is relatively new, but, on account of the limited supplies of rotenone, pyrethrum, and the arsenicals, cryolite is now being more generally recommended for insect control. Recommendations have been published as to its use on a few species of insects, and since there are available unpublished data, which can be used as a basis for additional recommendations, this circular is being issued as a supplement to the published data. It is hoped that it will lead to the development of more closely correlated and less confusing recommendations for the use of cryolite, particularly with regard to dust mixtures. The information given is not to be considered as final and is simply based on the experimental data available in the Bureau; therefore it does not cover all uses of cryolite or the recommendations made by other agencies. The published literature on cryolite has been reviewed recently by Carter and Busbey (1) and by Marcovitch and Stanley (2).<sup>2/</sup>

Natural cryolite constitutes the largest source of cryolite for insecticidal purposes. This material contains approximately 90 percent of the toxic agent, sodium fluoaluminate. Another source of cryolite is the synthetic or processed material. A domestic synthetic cryolite is available which contains approximately 85 percent of sodium fluoaluminate, and until recently there was available an imported synthetic material which contained about 97 percent of sodium fluoaluminate. Cryolite can be used in the undiluted form, but in this form, in the more humid regions, its "dustability" is poor. Therefore, in an effort to improve this condition, inert materials, such as talc and pyrophyllite, in varying proportions, have been added to the undiluted cryolite. The addition of sulfur may also improve its dusting qualities. Hydrated lime is not used because cryolite decomposes even with small quantities of hydrated lime. It may also decompose to some extent and cause plant injury when mixed with such materials as bordeaux mixture, lime-sulfur, and calcium arsenate, especially if an excess of lime is present.

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<sup>1/</sup> The information in this circular was furnished by the Divisions of the Bureau responsible for research on the specific insects involved.

<sup>2/</sup> Underscored numbers in parentheses refer to Literature Cited (Page 8)

## Uses

Cryolite has had its greatest usefulness as an insecticide in the control of caterpillars; for example, its usefulness in the control of the sugarcane borer has recently been demonstrated, and it is also recommended for the control of the velvetbean caterpillar on soybeans, peanuts, and other legumes. It is useful as a substitute for lead arsenate in the control of the codling moth on apples in the semi-arid valleys of the Pacific Northwest, and of the gypsy moth as a pest of shade and forest trees in the Northeast. As a substitute for calcium arsenate it has been used against the tomato fruitworm on tomatoes, the bollworm on cotton, and several species of caterpillars affecting cabbage.

Cryolite has been useful in the control of various species of beetles. It has been used extensively for the white-fringed beetle on peanuts and other plants that will not tolerate arsenicals. In California it is used as a substitute for calcium arsenate for pepper weevil control. In the absence of rotenone, cryolite is used as a remedy for the Mexican bean beetle.

Cryolite is also used for the control of the walnut husk fly, but, with this exception, its insecticidal use has been chiefly confined to the control of caterpillars and beetles.

## Plant Tolerance

The commercial cryolites available during recent years have usually been found noninjurious to the crops mentioned in the tables of this circular, although a few cases of injury have been reported. In the Eastern States cryolite has been recorded as injurious to the fruit and foliage of apples and to the fruit of peaches. Its use on corn or grapes is not recommended because of injury to the crop. In New Jersey B. B. Pepper has directed this Division's attention to applications of cryolite affecting adversely the growth of tomatoes, snap beans, lima beans, cantaloups, and sweet corn.

## Dosages

Experimental work at hand indicates that the control obtained with cryolite on a given insect is mainly associated with the number of pounds of the sodium fluoaluminate applied per acre, rather than the quantity of dust mixture applied or the strength of the mixture. For example, irrespective of the percentage of cryolite in the dust mixture employed, the control of the tomato fruitworm depends upon the

amount of sodium fluoaluminate applied, that is, 40 pounds of a dust mixture containing 35 percent has been as effective as 20 pounds of a mixture containing 70 percent of sodium fluoaluminate. The most practical rate of application of the dust mixture will be dependent upon the equipment to be employed as well as the insect and the crop to be treated. The dosage required to give maximum benefit to the grower will also depend upon the margin of profit of the crop and the severity of insect infestation.

Table 1 lists several insects upon which there has been sufficient work with cryolite as a dust to serve as a basis for tentative recommendations, and it gives the strengths of dust mixtures currently recommended together with the corresponding quantities required per acre for adequate control. Usually in order to obtain adequate coverage the amount of material used per acre is increased as the plants become larger. For example, in California the investigations on the control of the tomato fruitworm on tomatoes have been rather extensive and show that three applications are required, and if a 70-percent mixture of sodium fluoaluminate is used, 20 pounds per acre is sufficient for the first application, 30 pounds for the second, and 40 pounds for the third. Table 2 gives the average quantity of sodium fluoaluminate to be applied per acre and the quantity of dust mixture to apply when it contains 90, 70, and 50 percent of sodium fluoaluminate, respectively. These quantities are based on the average of the dosages and strengths given in table 1 for each usage.

Table 1.--Quantities of cryolite dust mixtures and their sodium fluoaluminate content designated in current recommendations for the control of different insects

Insect	Crop	Quantity of dust mixture per acre per application		Sodium fluoaluminate content
		Pounds		Percent
Tomato fruitworm	Tomato	20	to 40	70
Tomato pinworm	Tomato	20	to 40	70
Lima bean pod borer	Lima beans	20	to 25	80
Mexican bean beetle	Beans	15	to 25	70
Tomato fruitworm	Beans	15	to 25	70
Pepper weevil	Pepper	15	to 25	50
Flea beetles	Tobacco	10	to 15	70 to 80
Bollworm	Cotton	10	to 15	70
Velvetbean caterpillar	Soybeans, peanuts, and other legumes	7	to 12	84 or 90 <sup>1/</sup>
White-fringed beetle	do	7	to 12	84 or 90 <sup>1/</sup>
Cabbage caterpillars <sup>2/</sup>	Cabbage and cauliflower	15	to 25	40
Sugarcane borer	Sugarcane	8	to 10	84 or 90 <sup>1/</sup>
Flea beetles	Potatoes	15	to 30	27 to 31.5
Cabbage looper	Lettuce	10	to 20	33

<sup>1/</sup>

Undiluted cryolite.

<sup>2/</sup>

The cabbage looper, the cabbage webworm, the tomato fruitworm, and climbing cutworms. Cryolite is only partially effective against the imported cabbage worm and diamondback moth.

Table 2.-- Quantities of sodium fluoaluminate required per acre per application in cryolite dust mixtures under current recommendations, together with equivalent quantities of mixtures of different strengths

Insect	Crop	Average quantity	Quantities of mixtures of			
		of sodium fluoal-	indicated sodium fluo-			
		uminate required	aluminate content			
		per application	90 percent	70 percent	50 percent	percent
		Pounds	Pounds	Pounds	Pounds	Pounds
Tomato fruitworm	Tomato	21	23	30	42	
Tomato pinworm	Tomato	21	23	30	42	
Lima bean pod borer	Lima beans	18	20	26	36	
Mexican bean beetle	Beans	14	16	20	28	
Tomato fruitworm	Beans	14	16	20	28	
Pepper weevil	Pepper	10	11	14	20	
Flea beetles	Tobacco	9	10	13	18	
Bollworm	Cotton	9	10	13	18	
Velvetbean caterpillar	Soybeans, peanuts, and other legumes	8	9	$\frac{1}{2}$	$\frac{1}{2}$	
White-fringed beetle	do.	8	9	$\frac{1}{2}$	$\frac{1}{2}$	
Cabbage caterpillars	Cabbage and cauliflower	8	9	11	16	
Sugarcane borer	Sugarcane	8	9	$\frac{1}{2}$	$\frac{1}{2}$	
Flea beetles	Potatoes	7	8	10	14	
Cabbage looper	Lettuce	5	6	7	10	

<sup>1/</sup> Cryolite diluted with inert materials is not recommended at present for use against the velvetbean caterpillar, white-fringed beetle, and sugarcane borer.

<sup>2/</sup> See footnote 2, table 1.

Table 3 lists the insects for which cryolite has been used in the form of liquid sprays and gives the quantities and strengths recommended. The indications are that cryolite applied as a spray is more effective per pound of sodium fluoaluminate than when applied as a dust. This is probably due to better coverage and adherence, especially when an adhesive such as linseed oil or fish oil is included in the spray mixture.

Table 3. -- Quantities of cryolite required per acre per application in cryolite spray mixtures under current recommendations for the control of different insects

Insect	Crop	Quantity of undiluted cryolite/ recommended per 100 gallons of water		Quantity of spray mixture applied per acre		Quantity of undiluted cryolite required per acre	
		Pounds	Gallons	Pounds	Gallons	Pounds	Gallons
Gypsy moth	Forest and shade trees	6 <sup>2/3</sup>		500 to 700		30 to 40	
Codling moth <sup>3/</sup>	Apples or pears	3 <sup>4/3</sup>		800 to 1,200		24 to 36	
White-fringed beetle	Soybeans, peanuts, and other legumes	12.5 <sup>5/</sup>		150 to 200		19 to 25	
Mexican bean beetle	Beans	8 to 10		100 to 125		8 to 12	
Hornworms	Tobacco	12		75		9	

<sup>1/</sup> Both a synthetic cryolite, containing approximately 85 percent of sodium fluoaluminate, and natural cryolite, containing 90 percent, are used in the Southeastern States. The natural cryolite is most commonly used in the Western States.

<sup>2/</sup> The addition of 4 fluid ounces of linseed or fish oil per pound of cryolite greatly increases the adherence of the cryolite.

<sup>3/</sup> In the Pacific Northwest.

<sup>4/</sup> With 1 pint of fish oil or 1 quart of light or light-medium mineral oil emulsion.

<sup>5/</sup> With 3 pints of fish oil or linseed oil.



Cryolite has also been used successfully in a bait containing corn meal for the control of the tomato fruitworm on tomatoes and on beans and cabbage. The formula recommended is 1 pound of cryolite containing 85 to 90 percent of sodium fluoaluminate to 9 pounds of corn meal, the bait being scattered over the plants at the rate of 40 to 80 pounds per acre of tomatoes and beans and 25 pounds per acre of cabbage. For the tomato fruitworm on tomatoes 5 to 6 pounds of sodium fluoaluminate per acre applied in the corn-meal mixture have given results comparable to those obtained by the use of 21 pounds applied in a cryolite dust mixture.

### Warning

While cryolite is probably not so highly toxic to warm-blooded animals as are the arsenicals, it should be handled with the same care as is used in handling the more poisonous materials. The hands and exposed parts of the body should be washed thoroughly after working with this material, and care should be taken not to inhale excessive quantities of the dust. This can be avoided by the use of well-designed respirators.

Cryolite should not be applied to plant foliage that is to be used for food. It is difficult to remove residues successfully from such plants as cabbage, lettuce, and leafy vegetables such as kale, turnips, swiss chard, and broccoli. Cryolite should not be applied to lettuce within the period of 35 days before harvest. It should not be applied to cabbage after the heads begin to form -- in other words, after the central leaves cease unfolding and begin to become compact. This usually occurs 30 to 40 days before harvesting normally begins. Undesirable residues are likely to be found on tomatoes or lima beans if applied within 2 weeks of harvest and on snap beans or peppers if applied after the pods begin to form. However, if late applications are necessary on tomatoes, beans, or peppers, it is possible to remove cryolite residues from these products, as well as from apples and pears, by proved washing or wiping methods, and any residues present must be removed before the products are marketed or eaten.

### Literature Cited

- (1) Carter, R. H., and Busbey, R. L.  
1939. The use of fluorine compounds as insecticides, a review with annotated bibliography. U. S. Dept. Agr. Bur. Ent. & Plant Quar. Circular E-466 (processed), 145 pages, 692 references.
- (2) Marcovitch, S., and Stanley, W. W.  
1942. Fluorine compounds useful in the control of insects. Tenn. Univ. Agr. Expt. Station Bul. 182, 46 pages, illus., 96 references.